



# **Standby Power and Other Low Power Modes**

**Alan Meier**  
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# Plan



## **Background to “literature review”**

**A rapid overview of:**

- 1. Measurements**
- 2. Programs**
- 3. Research**
- 4. California summary**

- Goal is to provide the group a sense of present situation and to prepare for efficient discussions**

# Measurements of Low Power Modes



- **Goal: Compile and review field measurements (with special emphasis on California)**
- **Measurement approaches:**
  - Whole-building**
    - *Problem: obtaining enough buildings to be representative*
  - “Bottom-up”**
    - Existing products
    - New products
    - *Problems: getting usage patterns and saturations of minor products*

# Field Measurements (2)



## Sequence of presentation:

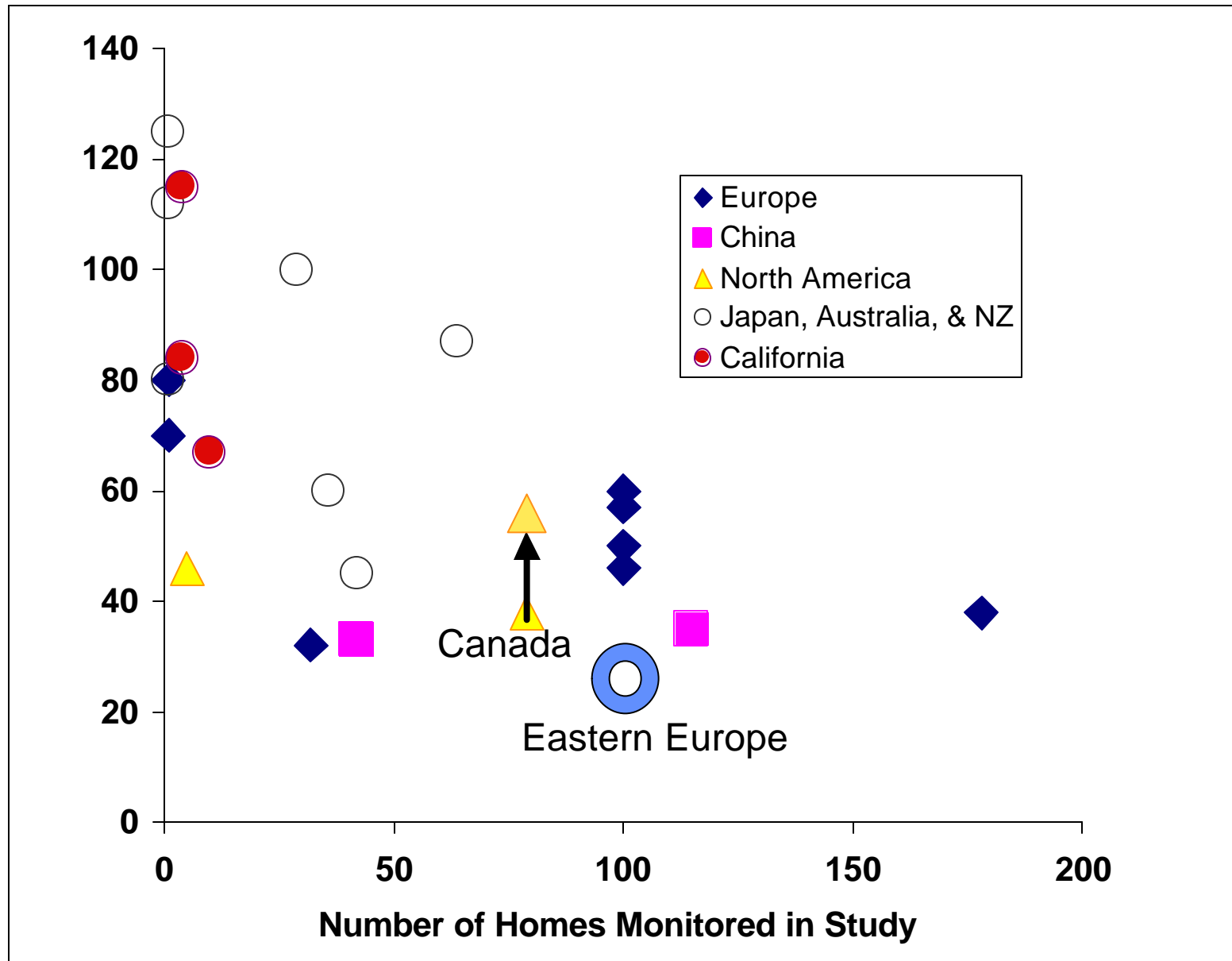
1. Residential
  - a. Whole building
  - b. Bottom-up
2. Commercial
  - a. Sleep/standby
  - b. Combined

# Whole-House Measurements



- **> 20 Studies identified**
  - Over one thousand homes in 17 countries
  - Only one formal study in California/USA (10 homes)
    - Data collected informally on 13 other homes in USA
- **Nobody explicitly measured sleep modes**
  - Measurements sometimes made in observed mode
  - Sometimes sleep mode is also lowest power mode
- **Field measurements underestimate low-power mode energy use**

# Field Measurements of Standby

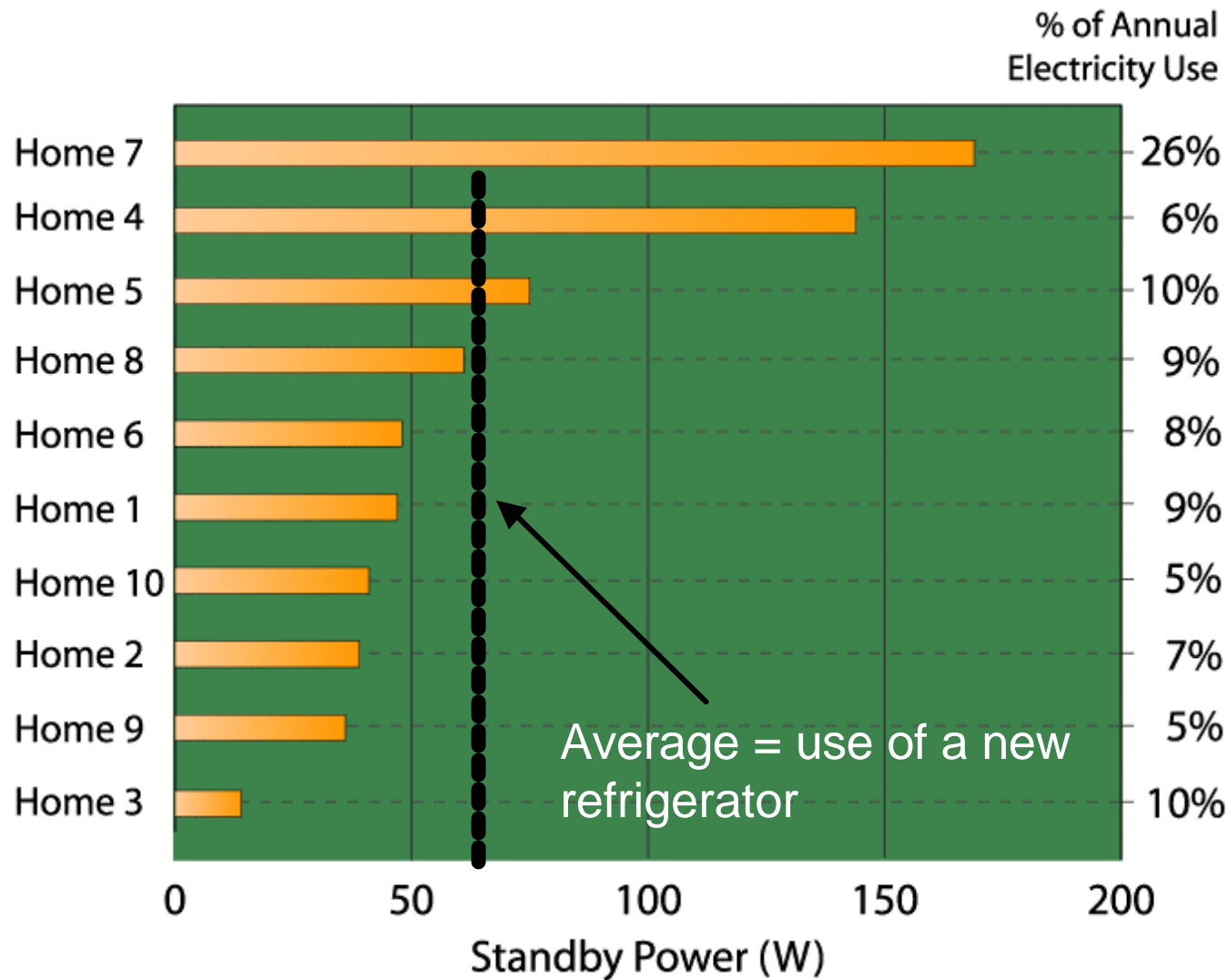


# Observations



- **Australia/NZ & Japan appear to have highest standby**
- **No sleep measurements**
- **No data on growth rates**
- **USA/California**
  - **No significant standby measurements in**
  - **Large variation among the few US measurements**
  - **20 standby appliances per home**
- **Probable California situation:**
  - **~10% of residential electricity use**
  - **~70 Watts/home**

# California Standby Measurements (1)



# Standby in One California House

Product	Model Year	Stand-By (Watts)
ATT Broadband Cable Box	1998	34 W
Sony 20" Color TV	1998	14 W
Sony VCR	2000	13 W
Garage Door Opener	1980	12 W
Sony 27" Color TV	1993	11 W
Bose Acoustic WaveNCD	2000	6 W
HP Desk Jet Printer	1995	5 W
Hitachi Laptop PC AC Adapter	1998	4 W
Panasonic Clock Radio	1995	3 W
Indoor TV Antenna Amplifier	1998	3 W
Outdoor Motion Detector	2000	3 W
Intermatic Timer	1985	3 W
2 <sup>nd</sup> Timer	1985	3 W
Clock Radio	1980	2 W
Motion Detector	2001	2 W
Hamilton Beach Coffee Pot	2000	1 W
<b>Total</b>		<b>122 Watts</b>

## Missing:

- Microwave
- Cordless phone
- Chargeables

## Still to come:

- White goods
- TV adapters
- Ceiling fans

Standby power use  
is increasingly  
common among  
white goods

QuickTime™ and a  
Photo - JPEG decompressor  
are needed to see this picture.

5W



# Bottom-Up Measurements

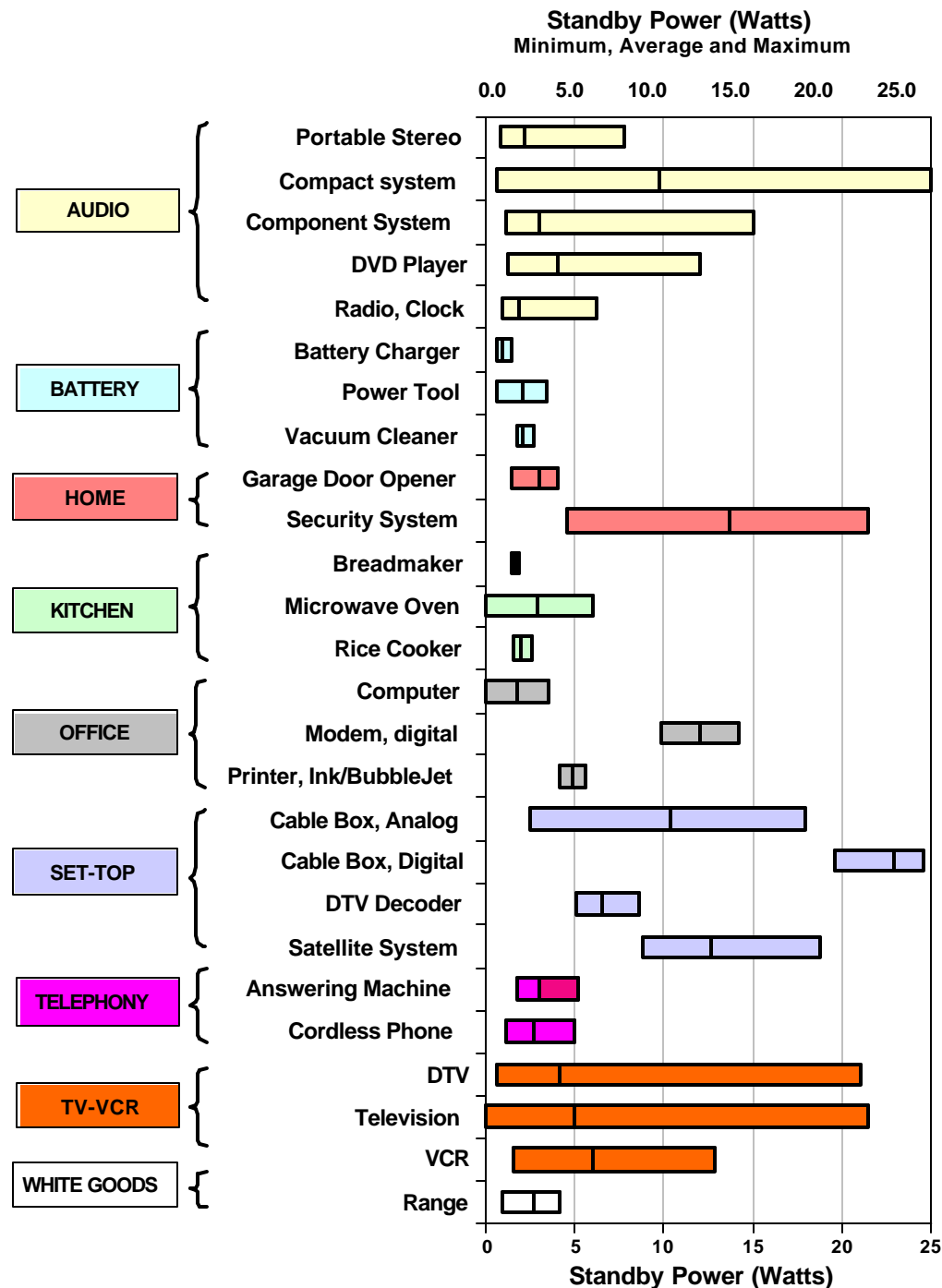


- **Useful for**
  - **Estimating regional energy use**
  - **Exploring impacts of new products**
  - **Time trends**
- **No information about**
  - **Enabling rates for power management**
  - **Unplugging rates and actual conditions**
  - **Saturations of minor products**
  - **Hard-wired standby**

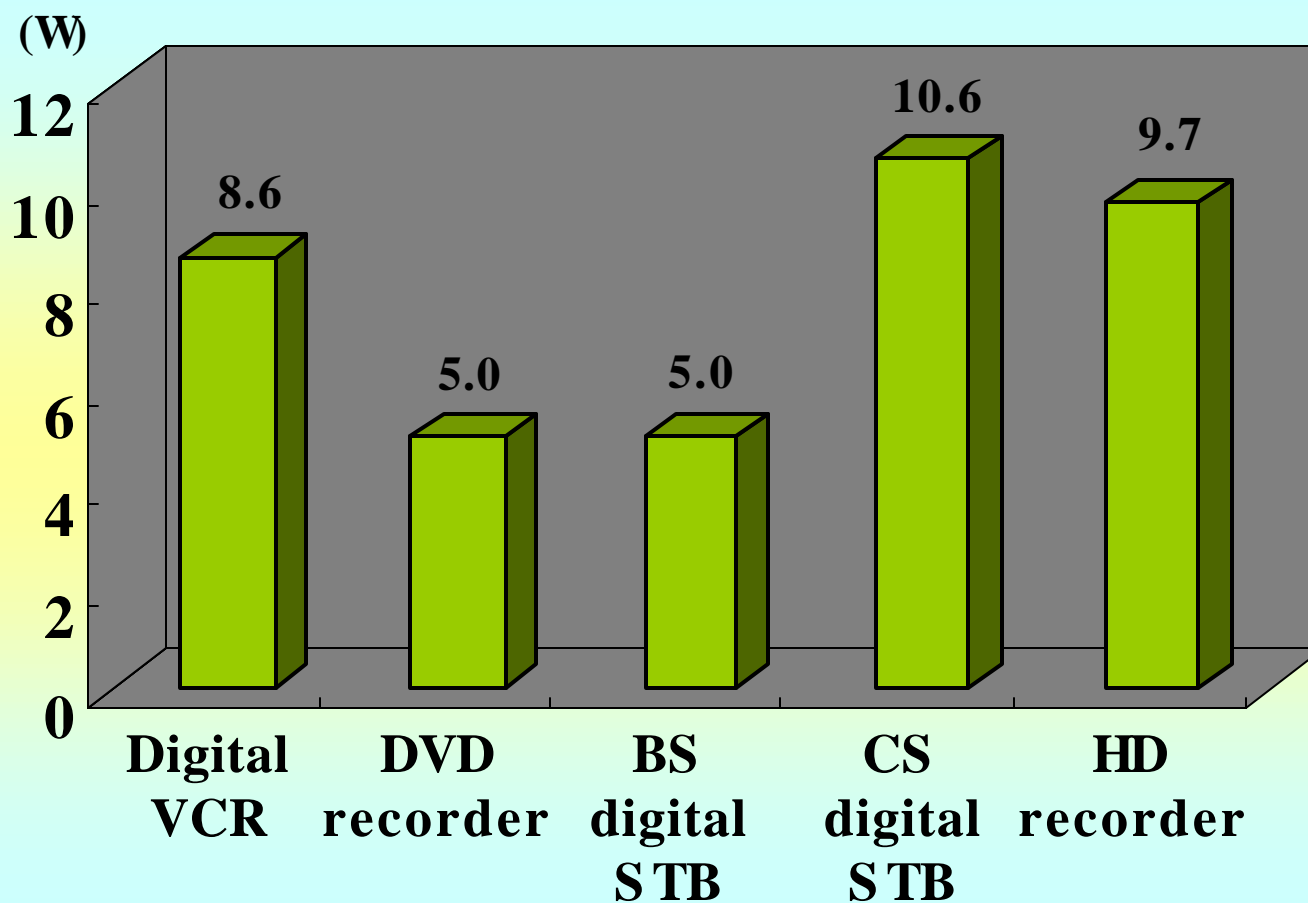
# Summary of individual measurements

1 watt = 9 kWh/year

Source: <http://standby.lbl.gov>

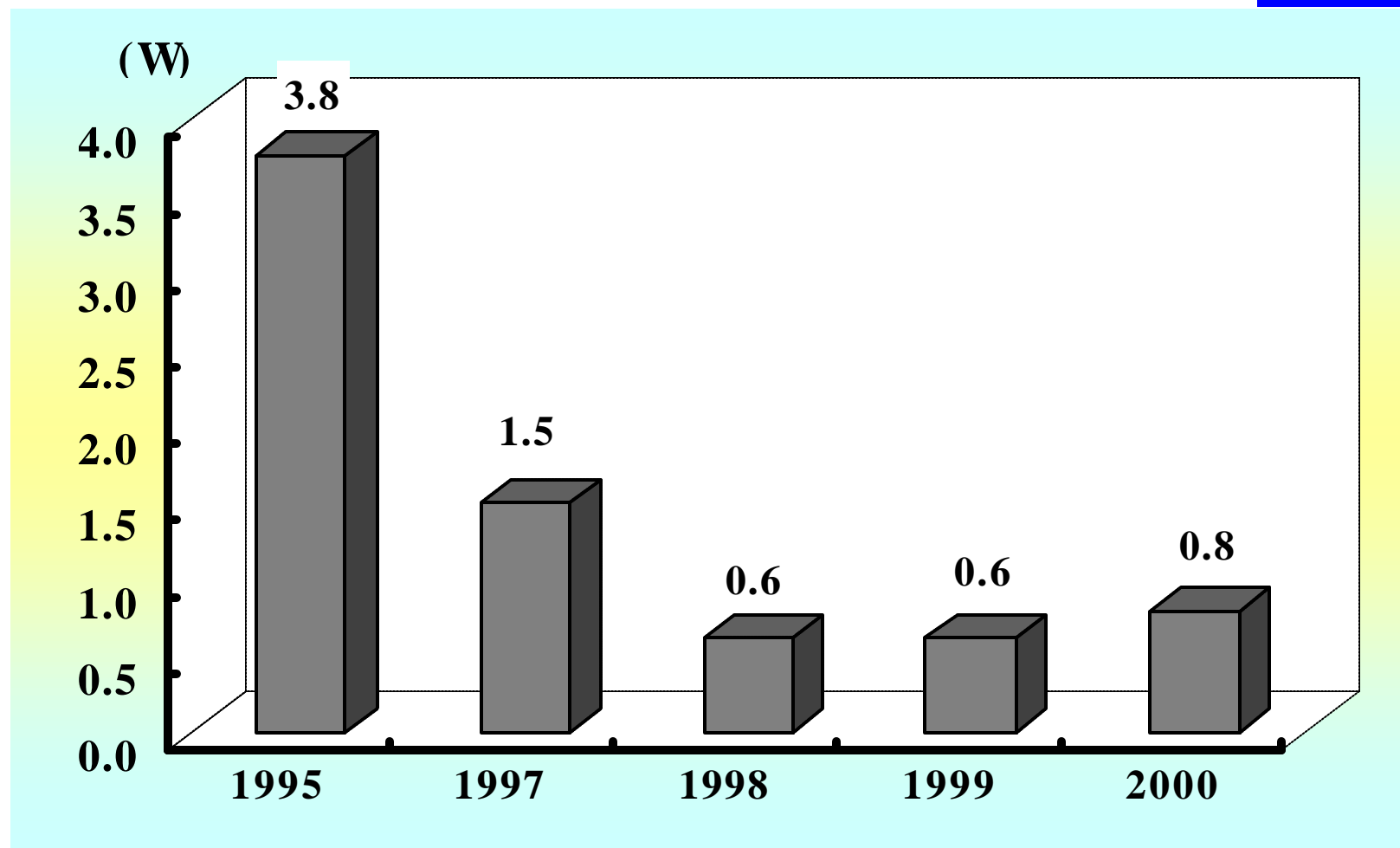


# Stand-by Power of Digital AV appliances in Japan



Source: Jyukankyo Research Institute

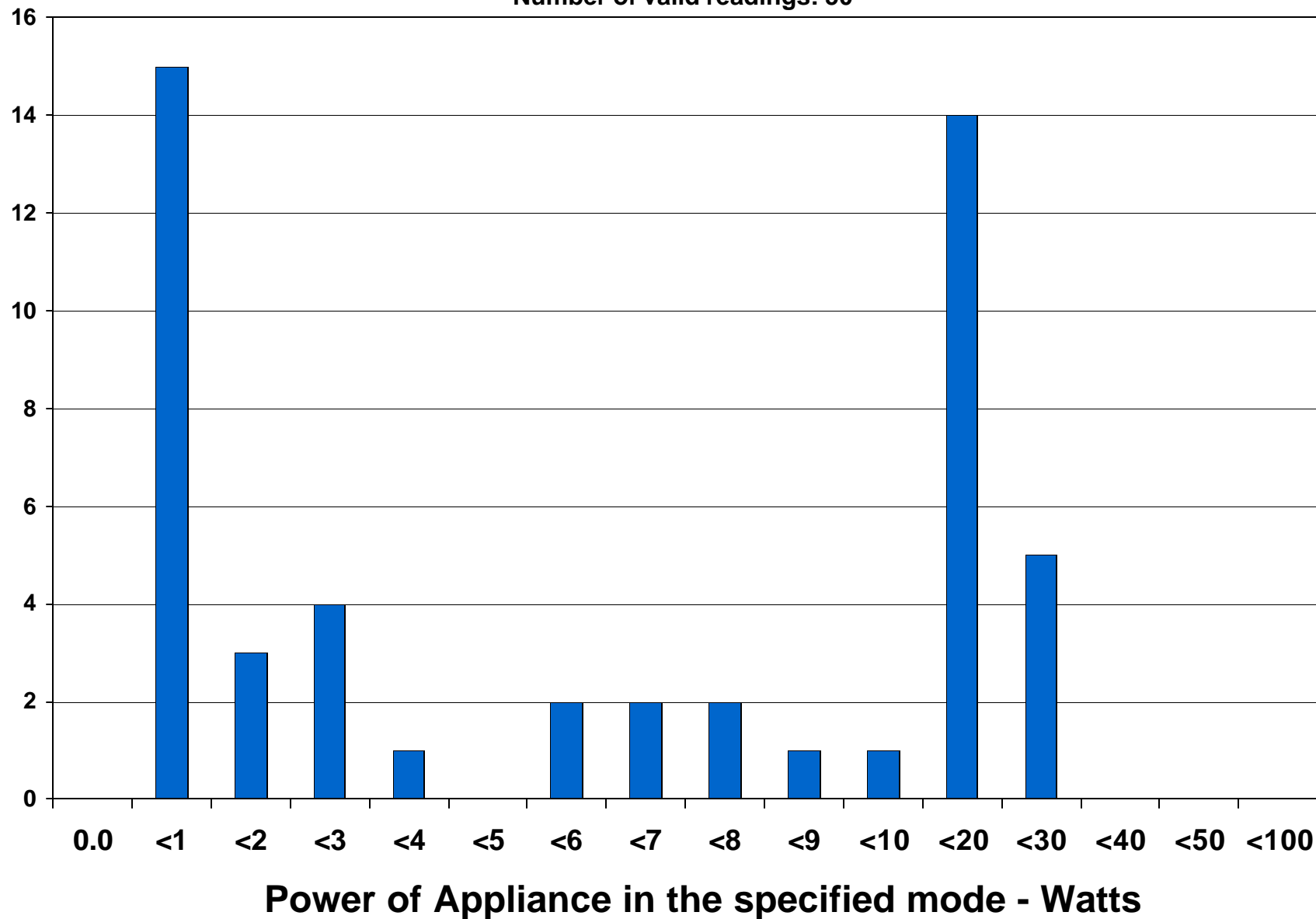
# Stand-by Power by Product Year for Japanese TV Sets



Source: Jyukankyo Research Institute

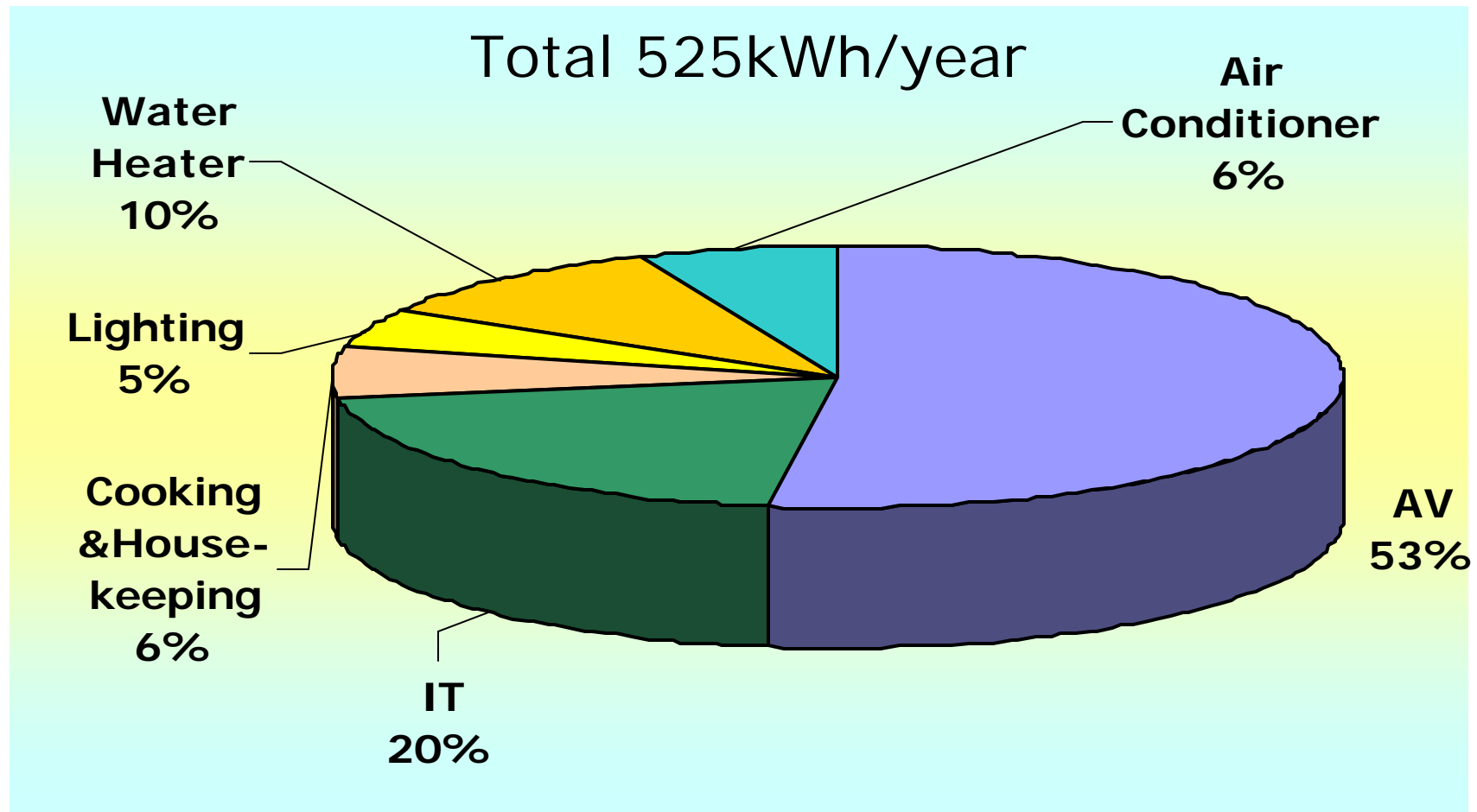
# Australia - Integrated Stereo Systems

Number of valid readings: 50



Source: Lloyd Harrington, Energy Efficient Strategies (Australia) 2002

# Standby Bottom-Up Estimate - Japan



Measured standby (W) in 1999; number of appliances owned in 2001; schedules from 2001 survey. Source: Jyukankyo Research Institute

# Commercial Buildings



- **No whole-building measurements of standby and low power**
  - **Some measurements of “night time power use”:**
    - 0.17 W/ft<sup>2</sup> (deGroot - Belgium)
    - 0.06 W/ft<sup>2</sup> (Meier - office equipment standby only)
- **Few bottom-up estimates of standby and low power for USA for office equipment**
  - **Some surveys of modes in office equipment**
- **Definition problems: scope and mode**

# Measurement Gaps



- **Low-power measurements in US homes**
  - Whole-house
  - Individual products
  - Times in different modes
- **Special study areas**
  - set-top and converter boxes
  - digital appliances
  - hardwired standby
- **Commercial buildings - all aspects**
  - Whole building
  - Products
  - Times in different modes

# ***Programs Related to Low Power Modes***



- **Types of programs**
  - **Test procedures**
  - **Certification**
  - **Labels**
  - **Mandatory regulations**
  - **Corporate goals**

**Please see documents for details**

**Example programs....**

## Programs...

Program/ <i>Activity</i>	Region	Covered Devices	Stand -by	Sleep Mode	Active Power
Energy Star consumer electronics <i>Certification</i>	US, Australia, Canada, Taiwan	TVs, VCRs, set-top boxes, audio, etc.	Yes	No	No
Energy Star office equipment <i>Certification</i>	US, Europe, Japan, Australia, Taiwan, Canada	Computers, monitors, printers, copiers, fax	No	Yes	No
European Code of Conduct <i>Certification</i>	Europe	TVs, VCRs, IRDs, low V. power supplies	Yes	Yes	No
Top Runner <i>Mandatory</i>	Japan	Office Equipment & Electronics	Yes	Yes	Yes
Appliance Standards Program <i>Mandatory</i>	US	Major domestic appliances	No* Except Refrig.	No*	Yes
Federal Energy Management Program (FEMP) <i>Purchasing spec.</i>	US	All plugged-in devices	Yes	No	No
International Electrotechnical Commission (IEC) <i>Test procedure</i>	InternŃl	All plugged-in devices	Yes	No	No

# Comments on Programs



- No programs *systematically* address both standby and sleep
  - Energy Star is largest program addressing sleep or standby
  - Increasing balkanization in programs to address low power modes
  - No common test procedures
- Most regulatory standards cover active but not standby/sleep
  - Test procedures for white goods don't capture standby

# Potential Programs



- **Mandatory maximum levels for standby power use in certain products or components**
- **“Vampire” buy-down program**
- **Minimum efficiency standards for power supplies**
- **Limiting hard-wired standby power use in new homes**
- **Establish a common communications protocol for cable service providers**

# Reducing Energy Use of Low Power Modes: Research Directions

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- **Diverse products means diverse strategies**
- **Little research explicitly directed towards reducing low power modes**
  - Often addressing other problem or goal
  - “borrowed technologies”
- **Efficiency strategies:**
  - Improve efficiency of components
  - Software improvements that permit equipment operation to better match functional needs
  - External improvements

# Hardware Improvements



- **Increase efficiency of power supply**
  - No load
  - Part load
  - Move switch to high-voltage side
- **Reduce power draw of circuitry**
  - De-energize components not needing use
  - Design ultra-low power circuits
  - Design special sensor-circuits for very low power modes (to sense network, voice, face, motion, etc. signals)
- **Reduce power of I/O components**
  - Displays are particularly important

# Software Improvements



- Better match operational components with functional needs
  - Active --> sleep
  - Sleep ---> deeper sleep
  - Sleep --> off
- May result in *increased* energy use in low power modes (but less active)
- Solutions will depend on device

# Thermographs of Satellite/Internet/DVR Box



**“OFF” - 17 Watts**

**ON - 21 Watts**



Power Supply

Microprocessor

*Some components are energized even when signal is unavailable*

# External Changes



- Improved communications protocols to enable more (or deeper) sleep modes
  - Cable TV & set-top boxes
  - Networked homes & appliances
- A building-wide DC power network
- Improved user interfaces
  - Encourages users to enable power management and exploit low-power modes

# Research Topics



- Develop communications protocols for networks to accommodate the lowest possible power modes while not in active
- Improve power supply efficiency, especially at part loads
- Improve power management, possibly with more modes
- Develop dimmable displays linked to information from sensors
- Explore viability of DC networks for commercial and residential situations
- Investigate technologies to reduce standby in “hardwired” devices
- Standardize user interfaces to encourage greater reliance on low power modes
- Optimize battery charging circuitry
- Long-term: explore ultra low-power circuitry and ways to supply power to it

# California



## Residential standby

- Recommended value: 70 W/home (~10%)
  - ~900 MW    800 GWh/yr
  - No estimate on sleep mode
- Commercial buildings
    - Low power in office equip only: 1100 GWh/yr

# California Trends



- Residential growth likely
  - Reductions in TVs, VCRs, audio
  - Growth likely from set-tops/converters, digital appliances, home networks, white goods, hard-wired devices
- Commercial trends
  - ???
- *Overall, energy use of low power modes is likely to be growing faster than almost all other end uses*

# California Energy Analysis



- Obtain better estimates of actual energy use of low power modes in homes and commercial buildings
  - Direct measurements
  - Surveys of behavior
- Examine trends in new products
- Investigate energy savings potentials in key products
- Estimate statewide savings



**End**